# FAO FISHERIES BULLETIN

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*Printed in Italy*

*Figure 1.* The quality of the dried salted fish being sold at this market in Ecuador might well be improved through the efforts of Dr. Carlos Gonzalez who recently completed an FAO project to help improve fish processing and marketing in Ecuador.

*Figure 2.* This Accra canoe in Liberia is of the type being provided to H. van Pel, an FAO expert, for carrying out experiments there towards the mechanization of local fishing craft and gear.

# SOME ASPECTS OF THE PRIMARY PRODUCTIVITY OF THE SEA *

## I. Introduction

Fisheries research deals with a multitude of different problems, ranging from questions on conditions in the sea that are favorable or unfavorable to the occurrence of fish to matters regarding the marketing of finished products. Here we shall deal with only one of the basic problems, that of the conditions in the sea which are necessary for the primary production of organic compounds. This topic, to which great attention is directed in oceanographic research, is very important because of its relation to the abundance of fish food, a determining factor in the availability and abundance of fish and obviously the magnitude of fisheries in any region.

In the sea, as on land, it is only plants which are able to produce organic matter from inorganic substances. All animals live directly or indirectly on plants. When dealing with the basic productivity of the sea we must, therefore, consider the synthesis of organic matter by the marine plants and the conditions that are favorable to such synthesis. A study of these conditions requires the co-operation of biologists, chemists and physicists, but we shall review them mainly from the point of view of the physical-chemical oceanographer.

It must first be pointed out that marine plants synthesize organic compounds by processes which are quite similar to those by which the land plants build up corresponding substances, meaning that the principal requirements of all types of plants are alike. Carbon dioxide and water are required for synthesizing carbohydrates and for building up the more complex fats and proteins; fertilizing substances containing nitrogen, phosphorus and small amounts of other elements like sulphur, iron, copper and, in some instances, nickel, iodine or even arsenic, must also be available. The building up requires energy which the plants obtain from sunlight, for which reason the process is called photosynthesis.

Land plants obtain carbon dioxide directly from the air. A few can utilize the water vapor in the air, but most plants receive water through their roots. The fertilizing substances must be present in solution in the water taken up by the roots. The principal importance of the soil is that it contains, or can be supplied with, fertilizers soluble in water and thus made available to the plants.

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* By H. U. Sverdrup, Professor of Geophysics, University of Oslo, Oslo, Norway.

In addition, the soil furnishes "holdfast" for the plants, but this function is of no importance to the production of organic compounds, and many plants have been grown successfully without soil. This can be achieved by attaching plants to chicken wire stretched out over a basin containing a weak solution of fertilizing substances and into which the roots of the plants extend and obtain all the materials needed for photosynthesis. The growing of vegetables without soil (hydroponics) may eventually be done on a commercial scale, but, so far, the necessary solutions are too expensive.

## II. Conditions for Plant Growth in the Sea

Turning to conditions in the sea, it may be stated that sea water contains ample quantities of carbon dioxide that sea water in general can be considered a very weak solution of such nutrient salts as phosphates, nitrates and others, and that sunlight penetrates to considerable depths. Therefore, conditions for photosynthesis are generally present, but they depend upon the depth to which the light reaches and upon the concentration of the nutrient salts.

The depth in the sea at which the average light intensity for 24 hours is sufficient for photosynthesis varies with latitude and with the transparency of the water. The less the transparency, the shallower is the zone, the euphotic zone, in which photosynthesis is possible. In coastal waters, the transparency is generally much less than in the waters of the open sea ; in higher latitudes it is lesser than in the tropics. At about 60° N, light conditions permit seaweeds and kelp to thrive between the surface and a depth of 15 to 20 m., whereas in the tropics sessile marine plants may be found to a depth of 80 to 100 m.

Some of the kelps may reach such dimensions that one may talk about forests in the sea. Off the coast of Chile, one of the giant kelps of the Pacific may reach the surface from a depth of 80 m., but in the North Pacific, off the coast of California, the richest kelp beds are found where the depth to the bottom is about 15 m. In several places the kelp is harvested and is used for the manufacture of alganin and similar products, but no data are available to show the rate of growth of kelp or other types of large attached algae.

Although kelp and other seaweeds are the only conspicuous marine plants, their contribution to the total production of organic matter in the sea is relatively small because they are confined to the shallow coastal areas and the extent of their habitat is thus relatively small. The free-floating Sargasso weed represents an exception to this rule, but is never found in the fantastic amounts which are described in some of the tall tales of the sea.

The bulk of the organic matter synthesized in the sea is produced in the open ocean by microscopically small floating plants, which may

occur in numbers of several million per liter. In some instances they may be so abundant that the water is discolored; "red water" is not uncommon in sub-tropical localities. The Red Sea has derived its name from the occasional appearance of enormous numbers of certain algae, and the Spanish name for the Gulf of California, the Vermillion Sea, refers to discoloration by certain dinoflagellates.

The many species of very small plants of the sea are kept in suspension in various ways. Most of them are so formed that they sink very slowly, and many contain tiny droplets of oil. The point in this connection is that there are plants which are adjusted to live in the surface layers of the sea and are able to produce organic matter if there is sufficient light and fertilizing substances.

As far as light and temperature conditions are concerned, the total oceanic region favorable to plant growth is far more extensive than the regions suitable for land plants. In the sea, plants can utilize light within a layer from 10 to 100 m. thick, but most land plants are low and make use only of the light within the lowest few meters, or less. Furthermore, the oceans cover about seven-tenths of the surface of the earth ; of the three-tenths that represent the land areas, large portions are unsuited for plant growth. Some regions are covered by glaciers, others are mountainous and are too cold or are lacking in soil, whereas others are deserts and lack water.

From this point of view one might expect the total production of organic matter to be many times larger in the sea than on land, but we have neglected a very important factor : the available amounts of fertilizing substances.

On land a certain amount of "natural fertilization" takes place. Metabolic products are made available rapidly to the plants. Dead organisms decay on the spot and the mineral substances which they contain are thus released to serve the needs of new generations of plants. In the sea, however, metabolic products and remnants of plants and animals sink towards the bottom and thereby the organic compounds are constantly removed from the euphotic zone in which the principal plant growth takes place. Although these remnants decay as they sink and their mineral substances ultimately enter into solution, this process takes place at depths in which darkness prevails. However, the process that on land leads to enrichment of the strata of the media in which plants grow, in the water leads to enrichment of deep strata and, in fact, to a deprivation of the surface waters. Where land is under cultivation fertilizers are added and, moreover, sub-surface soil which has been enriched by some sinking of the nutrient materials, is brought to the surface by plowing. In the sea, if the distribution of plant nutrient salts were determined only by the decay process of "natural fertilization," the surface layer would soon be practically sterile and life would disappear from most of the ocean areas. Conditions for limited plant growth might be present only in coastal areas where river waters carried small amounts of fertilizing matter into the sea. However, we have no reason to believe that the productivity in the sea is decreasing and must, therefore, conclude that processes operate

by which the surface water, poor in nutrients, is replaced by water rich in nutrients from greater depths. We may say that in order to maintain productivity, the ocean must be plowed, and the deeper it is plowed, the greater is the yield. It follows that the relative productivity of land and sea areas cannot be judged unless we know much more about how the fertilizing substances of the surface layers are renewed and how efficient the renewal is within the different ocean regions.

It has been said that deep water is "rich in nutrients," but actually, the concentrations are very low. Even where the largest quantities occur, the amount of nitrogen (dissolved nitrogen gas excluded) is only about $\frac{1}{2}$ gram per ton of sea water and the amount of phosphorus is about $\frac{1}{10}$ gram per ton. However, marine plants can utilize very weak solutions and can, for instance, take up nitrogen compounds even if the nitrogen content is below $\frac{1}{100}$ gram per ton. Plants containing nickel must be able to extract nickel from water that holds less than $\frac{1}{10,000}$ gram per ton.

The concentrations of the nutrient salts in the sea are small, but still the total amounts are enormous because of the great volume of water in the oceans. In a semi-circular bay which is, say, 8 Km. wide and on an average 300 m. deep, the total amount of nitrogen is 800 tons even if the average concentration is only 0.1 gram per ton. These figures alone show that an attempt at increasing production by adding fertilizers to the sea would require such enormous expenditure that the venture would be economically impossible. In exceptional localities, such as in nearly land-locked waters with very restricted communication with larger bodies of water, addition of fertilizing substances during the growing season may be effective, but in the ocean the fertilization of the surface layers must be left to natural processes.

Since the deeper layers are always relatively rich in nutrients, fertilization must take place either by processes which lead to a mixing of deep and surface waters, or by which water is drawn to the surface from a moderate depth. In general, the nutrient content increases with depth, therefore, the greater the depth from which the deeper water rises, the more effective the fertilization of the surface layer. It may be said that to give a high yield, the ocean must be plowed, and the deeper it is plowed, the greater the crop will be.

## III. Plowing the Sea Surface

Two agents are effective in this operation: the wind and the winter cooling. In addition, mixing of currents of different origins is effective.

The wind acts over all ocean areas, but in most regions it does not plow to any appreciable depth. Waves and currents set up by the direct action of the wind produce a thorough mixing of the

water near the surface, but this intense mixing rarely makes itself felt to depths exceeding 80 or 100 m. In higher latitudes, this mixing is of some importance because it means that over a period of time plants can utilize all the nutrients present in the upper 80 to 100 m., not only those found within the 15 to 20 m. thick layer in which there is enough light for photosynthesis. In the tropics, the stirring by wind and waves are less important because there the light is sufficient for photosynthesis in the entire wind stirred layer.

However, the stirring does not cease abruptly at any fixed depth, although the intensity of the stirring decreases with depth. This means that a certain amount of mixing takes place near the bottom of what we have called the "wind stirred layer" and that through this mixing, small amounts of deeper water with its nutrients are exchanged with equal amounts of water from the depleted surface layer, so that moderate production may be maintained. The effect of this small upward transport of nutrients may be important in the tropics, where, because of the high temperature, the processes of decay may be so rapid that the mineral substances may be brought into solution close to the surface and thus be made available immediately, but these matters require further investigation. Even if such conditions exist, the fact remains that the direct stirring by wind currents and waves does not reach such depth that regions of high productivity are found where the plowing of the ocean depends upon the direct effect of the wind alone.

Along some coast lines a secondary effect of the wind is far more important. In order to explain this, it must first be stated that, because of the rotation of the earth, the total transport of water by the wind current is directed at right angles to the wind, to the right in the northern hemisphere and to the left in the southern. Furthermore, only a shallow surface layer is transported by the action of the wind on the sea surface. This means that off a coast where the transport by the wind current is directed away from the coast, the surface layer will be carried away and must be replaced by water that rises from some depth.

Let us consider conditions off the coast of California. From February until June or July the prevailing wind blows from the north, parallel to the coast; this wind tends to transport the surface layer westwards away from the coast. This surface layer is replaced by water which rises from a depth of 200 to 300 m. This "upwelling" water is rich in plant nutrient salts, and permits the development of large plant populations since the upwelled water spreads to distances of about 50 to 100 miles from the coast. These populations support numerous higher forms of life, including large masses of the Californian sardine which have given rise to important fisheries since the late 1920's. Thus, we find here an example of the relation between the supply of fertilizing substances and the possibility for commercial fishing.

The sardine catches have, however, shown great variations, from over 500,000 tons a season to about 100,000 tons a season. The catches along the different parts of the coast have varied greatly. Since 1949, a large project has been in operation to determine how the great

changes in the catches from year to year are related to physical-chemical and biological conditions. It is possible that changes from year to year in the intensity of the upwelling or of the depth from which the water rises, may introduce changes in the supply of fertilizers to the surface layer and thus in the production of organic matter by the plants. In addition, conditions during the spawning season may affect the success of spawning or diseases may destroy large quantities of fish. Results are not yet available but, regardless of what they may be, it can confidently be expected that the outcome of such large-scale investigations should have important bearing on similar problems in other regions.

Conditions similar to those off California are found in other localities both in the northern and the southern hemispheres. Upwelling takes place off the coast of Morocco and the sea there is known to be very productive, with large quantities of fish. Intensive upwelling takes place off the west coast of South Africa, particularly between latitudes 35° S and 15° S. Important sardine fisheries have been developed in the southern part of this region in recent years. The development is controlled by the Government of the Union of South Africa in order to prevent excessive investment in ship and shore facilities before more is known about the possible large fluctuations in the available stock.

The most extensive region of upwelling is found off the coast of Chile and Peru, and these waters are perhaps the most fertile of all oceans, producing food for enormous quantities of fish. Until recently, commercial fishing has not been of particular importance there, but for years the fish have indirectly played a dominating role in the economy of Peru, because the main export has been the guano collected from islands where millions and millions of birds feed on fish. It has been estimated that the birds living on one small island group alone must catch between two and three million tons of fish in order to survive. The total amount caught by the birds must be many million tons.

The regions of upwelling, which are also very productive, can readily be recognized when examining charts showing the distribution of sea surface temperatures in different months. The upwelled water is cold, and during the months of upwelling the temperature of the water off the coast is therefore strikingly low. Off California, between latitudes 34° N and 41° N the water temperature in early summer is between 10° and 12° C (50° to 54° F), whereas in the corresponding latitude off Japan the temperature is above 25° C (77° F). Similarly off Peru, between latitudes 20° S and 12° S, the temperature remains between 16° and 20° C (61° to 68° F) the whole year, but in the same latitude in the western Pacific it varies between 22° and 28° C (72° and 82° F).

In the Pacific, upwelling also takes place along the equator, from the coast of Ecuador to a distance of Kms. 4,000 to 5,000 miles westwards. This feature is not related to the presence of a coast, but to the circumstance that to the north of the equator the prevailing easterly wind, because of the effect of the rotation of the earth, tends to carry the sur-

face layer to the right, that is, to the north ; whereas to the south of the equator, the deviation is to the left, to the south. Because of this divergence, water is drawn to the surface near the equator, carrying plant nutrients into the photosynthetic zone.

Since the sub-surface is cold, the upwelling leads to low surface temperatures along the equator. The intensity of the upwelling is greatest off Ecuador, where surface temperatures of 20° C (68° F) are found at the equator. This region is also one of very great productivity and is known particularly for the large amounts of tuna being caught by fishermen from California.

Deep plowing by wind is characteristic of lower latitudes, where the wind blows steadily from the same direction for long periods ; but in higher latitudes upwelling is such a transient phenomenon that it does not exercise any appreciable influence on productivity. In higher latitudes the winter cooling is the principal agent which leads to a renewal of the water of the surface layer. However, in this respect the conditions in the Antartic are exceptional, as will be shown later.

Winter cooling leads to an effective, and in many localities deep, plowing of the sea. When water in cooled, its density increases. When the surface layer is cooled, it becomes denser than the underlying water which does not lose heat, sinks and must be replaced by rising water. The depth to which surface water sinks depends upon how the temperature and salinity of the water vary with depth. In the northern part of the Atlantic Ocean, between Iceland and Greenland and between Greenland and Labrador, the salinity of the water is, in late winter, practically constant from the surface to the bottom, and the temperature of the deep water is around 3° C (38° F). Therefore, when the surface water has been cooled to about 3° it may sink all the way to the bottom and may be replaced by water from the greatest depths, 3,000 to 4,000 m. It may be said that the winter plowing may reach 3,000 to 4,000 m. there. The deep water is rich in nutrients, and when spring comes and the light increases, the plants are able to produce enormous quantities of organic matter which ultimately serve as food for large fish populations.

The sinking of surface water in the extreme northern part of the North Atlantic has important bearing on the high productivity of the Antarctic waters. Because of the character of the prevailing winds and the trend of the coast lines, surface water is carried across the equator to the north in amounts that are estimated at about 6 million cubic meters per second or about 45,000 cubic miles a year. Obviously, an equal amount must be carried to the south and must, sooner or later, rise to the surface. Observations show that part of the water that sinks around Greenland and part of the water that flows out along the bottom of the Straits of Gibraltar flow to the south as deep water. Together with water that has left the surface in the southern hemisphere, these water masses rise to the surface within the ocean that surrounds the Antarctic continent. During its travels to the south the deep water content of nitrates, phosphates and other matter has increased because of decay of sinking organisms, and the water

reaching the surface in the Antarctic has, therefore, a very high content of plant nutrient. Actually, the deep water of the Antarctic Ocean contains twice as much nitrate as that of the North Atlantic.

The productivity of the Antarctic waters is illustrated by considering the large population of whales. By international agreement, the annual number of whales caught in Antarctic waters has been limited in recent years to 16,000 so-called "blue whale units," each representing a weight of about 80 tons. Thus, the annual catch amounts to about 1.2 million tons, but this figure represents only a very small fraction of the total amount of organic matter produced by the plants in the region.

The productivity is also very high in such northern waters as the sea between Norway and Greenland and in the Barents Sea between Bear Island, Spitsbergen and Novaja Zembla. The former is divided into two basins with depths exceeding 3,000 m. and the basins are filled by water of constant salinity and of a temperature close to $-1^{\circ}$ C ($30^{\circ}$ F). When the surface temperature in the western part of the sea is lowered to about $-1^{\circ}$ C in winter, the surface water sinks and must be replaced by deep water. Again we have an example of "deep plowing."

In the Barents Sea the depths range between 100 and 400 m. and there the winter plowing generally reaches the bottom. In spring and summer, there is an abundant growth of plants, but the sea is so shallow that when the remnants of plants and animals sink, they are only partly decomposed on the way. Large quantities of organic matter accumulate on the bottom where they provide food for bottom animals and ultimately for bottom fish. Considerable amounts of flatfish are caught in the southern part of the Barents Sea, which is also a profitable fishing region for other fish.

Conditions in the northern North Pacific differ from those in the northern part of the Atlantic. Around Greenland and in the sea off Norway, deep plowing is possible because the last branches of the Gulf Stream system carry water of high salinity into high northern latitudes. Owing to its high salinity this water already has a high density and, when cooled in winter, attains such a density that it may sink to the bottom. In the northern North Pacific the Aleutian Islands prevent the high salinity water of the Kuroshio (the Japan Current) from reaching high latitudes; for this reason,one finds there an upper layer which, because of excessive precipitation, has a lower salinity and therefore a considerably lower density than the deeper water. When cooled in winter, the surface water sinks to a depth of only 200 to 300 m., that is, the winter plowing is relatively shallow. Still, it is efficient because in the North Pacific the content of plant nutrients increases more rapidly with depth than in the North Atlantic.

Intensive mixing accompanied by the rising of deeper water also occurs where currents meet, for instance, off the northern islands of Japan, where the Kuroshio encounters the Oyashio, the cold current from the Bering Sea or to the south of the Grand Banks of Newfoundland where the Gulf Stream meets the Labrador Current. Such regions are also regions of high productivity.

## IV. Conclusions

Summarizing the preceding description it may be said that the primary production of organic matter by marine plants takes place in the surface layer all over the ocean, but the total amount produced varies from region to region, and in most areas it varies during the year. In high latitudes the annual cycle is related to the altitude of the sun which determines the amount of light available for photosynthesis. In lower latitudes the annual cycle may be related to an annual period in the prevailing winds.

In all latitudes, an exchange of surface water with that from some greater depth is necessary because otherwise the plant nutrients would be completely removed. Some such exchange takes place everywhere, and therefore sterile surface layers do not occur, but great production is found only where the exchange is furthered by upwelling, winter mixing or mixing when currents meet.

Various attempts have been made at estimating the total amount of organic matter produced in the sea annually and at comparing this to the total amount produced by land plants. Off-hand, one might expect the primary production of the sea to be the greater, because the ocean surface is more than twice as extensive as the land surface, and because there are no sterile surface areas in the sea, whereas on land, mountains, deserts and glaciated regions are unsuited for plant growth. However, according to the latest estimates the primary production of the sea is about equal to that of the land.

The value of the primary productivity of the sea as human food is, however, smaller. The reason is that so far we are unable to make direct use of the marine plants and must confine ourselves to catching fish. This has the further disadvantage that, generally, fish do not feed directly on minute plants, but on other animals which may or may not be vegetarians. Therefore, between tho fish caught and marine plants there may be one or several links. It has been shown that at each link $^{9}/_{10}$ to $^{19}/_{20}$ of food consumed is used for metabolic processes, and only between $^{1}/_{10}$ and $^{1}/_{20}$ is stored. For instance, we have a series : *fish* feed on *small marine animals* which feed on *smaller marine animals*, which feed on *plants;* then the " food value " of the fish represents only between $^{1}/_{1.000}$ and $^{1}/_{10.000}$ of the " food value " of the plants. In view of such figures it may be tempting to speculate on the possibilities of harvesting the marine plants directly, but it is improbable that we shall be able to construct in the near future devices which will efficiently catch the microscopically small plants. We may have to leave the cycle in the sea alone, and try to obtain the maximun yield from the fisheries without running the risk of seriously depleting the stock. Numerous natural fluctuations add to the difficulties in ascertaining whether a stock is being overtaxed. A long period of systematic research is needed to arrive at valid conclusions. Studies of the primary productivity in the sea and of the fish population which can be sustained by the products of the plants are, therefore, of importance to long-range fisheries problems.

H. U. Sverdrup

# FISHERIES RESEARCH CENTER ESTABLISHED IN CUBA *

A Fisheries Research Center (Centro de Investigaciones Pesqueras) began operations on 9 March 1952 in Playa Habana, on the north coast of Cuba, about 30 kilometers from the capital. It is a subsidiary of the Department of Investigation of Natural Resources of the Agricultural and Industrial Development Bank of Cuba.

The Center's building, situated about 100 meters from the shore, is provided with an aquarium ; a laboratory, chemistry, refrigeration, centrifugal, incubating and retorting rooms ; library ; offices and employees' quarters. In the yards of the building there are four live storage tanks equipped with a continuous pumping system, an oxygen control unit and an emergency auxiliary system. The Center has three small motorized fishing boats and plans to acquire a research vessel.

## Staff

The technical staff includes :

Dr. Carlos G. Aguayo, who did research in marine biology at Woods Hole Marine Laboratory, holds a full professorship on Marine Zoology and Malacology at the University of Havana, and is the author of about 200 papers, university texts, booklets, scientific monographs and articles. Dr. Aguayo has described about 200 new species, principally mollusks, many of them marine.

Dr. Luis Howell Rivero, who did research in the laboratories of the Universities of Harvard and Michigan, is Assistant Professor of Zoology at the Faculty of Science of the University of Havana and Head of the Hydrographic Bureau of the Cuban Navy Department. He has written more than 60 papers on marine fauna, in which he has given records of new species in Cuban fauna and others new to science.

Dr. Isabel Pérez Farfante has done research in marine biology and embryology at Woods Hole Marine Laboratory, conducted studies and research in marine biology at the Chesapeake Biological Laboratory, as well as carried out research at the Museum of Comparative Zoology of Harvard University. She is Assistant Professor of Zoology at the Faculty of Science of the University of Havana and the author of about 40 papers, monographs, articles and lectures. Dr. Farfante has described 40 new species and sub-species of Cuban fauna.

Dr. Félix Soloni Toural, biochemist.

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* Information supplied by Dr. Gerardo Canet, Head, Information, Surveys and Reports of Natural Resources Branch, Agriculture and Industrial Development Bank of Cuba.

## Research Program

Research in marine biology is new in Cuba and for this reason the problems are many. The Research Center is trying to tackle the most pressing of them, and its program covers :

(1) A four-year program for investigating sea fisheries and other fishing areas of the insular shelf, and migratory movements of commercial species.

(2) Study of the life cycle of the Cuban oyster (*Ostrea rizophorae*) as well as investigations on the introduction of artificial substrates for attachment of oysters ; this will permit the expansion of present areas of exploitation and the use of new areas. Introduction of the American oyster (*Ostrea virginica*) which reaches a much larger size than the Cuban oyster and because it lives under different conditions, new beds can be established without prejudicing native species.

(3) Study of the spawning and migration areas of the lane snapper (*L. synagris*).

(4) Determination of the spawning areas and migrations of the spiny lobster and the hard-shell crab and investigations into methods of culture on a large scale and of artificial propagation.

(5) Explorations to locate the grounds of the large shrimp of the genus *Peneus*, especially the pink grooved shrimp known to exist in Cuban waters. Exploitation of the grounds located during the last few years in the Gulf of Mexico has produced millions of pesos annually.

(6) Studies of the plankton which constitutes the food of commercial species.

(7) Investigations on the diseases of sponges. Attempts will be made to sow non-contaminated areas and establish new fishing banks. Studies of the possibilities offered for sponge fisheries in areas deeper than those being exploited and experiments on sponge fishing methods used successfully in other countries.

(8) Statistical studies: a fisheries census in every port giving the quantity caught of each species in weight units and numbers and gear employed, personnel and type of fishing craft used as well as the economic structure of the industry.

(9) Study of methods of preservation, refrigeration, freezing, salting, canning of the different species.

(10) Study of transport and storage facilities.

# Fisheries Division Activities

## *Indo-Pacific Fisheries Council*

The Indo Pacific Fisheries Council held its fourth meeting in Quezon City, Philippines, from 23 October to 7 November 1952. In attendance were forty representatives of fifteen of the sixteen Member Governments of the Council and observers from the South Pacific Commission, UNESCO, the United Nations, Pacific Science Congress and FAO. The countries represented were: Australia, Burma, Cambodia, France, India, Indonesia, Japan, Korea, Netherlands, Pakistan, Philippines, Thailand, United Kingdom, United States, Viet Nam. Ceylon was not represented. The meeting was chaired by Dr. D. V. Villadolid, Director of Fisheries of the Philippines and 1951/52 Chairman of the Indo-Pacific Fisheries Council.

The Council, in reviewing its work program and laying plans for the coming year, emphasised the need for further training schools similar to those conducted by FAO in Indonesia and Thailand during the past year. It also requested additional technical assistance for the Far East, particularly in fisheries engineering, fish marketing and distribution. The Council adopted a report summarizing the present situation of oceanographic work in the Indo-Pacific region and made recommendations for international action to co-ordinate and advance this work. The report draws attention to the need for basic education and training in oceanography and suggests that the prosecution within the region of fundamental research in physical and biological oceanography is a field in which UNESCO might play an important role. It was expected that UNESCO would discuss this subject at its seventh session which takes place in Paris from 12 November to 10 December, 1952.

R. Serene, Director of the Oceanographic Institute, Nha Trang, Viet Nam, was elected Chairman of the Council and Boon Indrambarya, Director of Fisheries, Thailand, vice-chairman. These two officers, together with the outgoing chairman, Dr. D.V. Villadolid of the Philippines, make up the Executive Committee which guides the affairs of the Council between its meetings. The technical work of the Council is carried out mainly through committees which deal with tuna, neritic pelagic fisheries, fish culture, planktology, hydrology, taxonomy, seaweed, hilsa, chanos, and general biology, gear technology, food technology, socio-economics and statistics.

The Council agreed to hold its next meeting in Bangkok, Thailand, in January 1954.

*Hilsa Sub-Committee*

The Hilsa Sub-Committee of the Indo-Pacific Fisheries Council held a special meeting in Calcutta, India, 4 - 7 September 1952. In attendance were Dr. S.L. Hora, of India, Chairman, Dr. Nazir Ahmed, Pakistan and Dr. Cecil Miles, Secretary of the IPFC. Dr. Rahimullah Qureshi of West Pakistan and Mr. Davison, Technical Co-operation Administration Fisheries Specialist in Burma attended as observer.

Some sixty fisheries officers attended a symposium on " Hilsa and the Hilsa Fisheries " where the following papers were presented :

" Progress of Hilsa Investigations in India, " a review by N. K. Panikar, Mandapam.

" Biology of the Hilsa, " by S.L. Hora, Calcutta.

" Morphological and Serological Characters of the Hilsa, *Hilsa ilisha* (Ham.) with Reference to Racial Investigations, " by T.V.R. Pillay, Calcutta.

" Hilsa Investigations at the Central Inland Fisheries Research Station — Aims and Achievements, " by S. Jones, Barrackpore.

" Trends of Hilsa Prices in Calcutta Market, " by J.C. Biswas, Calcutta.

" Proverbs and Popular Sayings Concerning the Hilsa Fish Current in Bengal," by S.L. Hora.

" Past, Present and Future of the Hilsa Fisheries, in the Madras State, " by P.I. Chacko, Madras.

" Dams and the Problems of Hilsa Fisheries, " by K. Krieshnan Nair, Calcutta.

" A Preliminary Biometric Study of Certain Populations of Hilsa, *ilsa ilisha* (Ham.)," by T.V.R. Pillay.

" Hilsa Fishery in Bihar," by C.P. Varma, Patna (Bihar).

" The Palla of Sind, " by Dr. Rahimullah Qureshi, Karachi.

" Hilsa Fishery of East Bengal, " by Dr. Nazir Ahmed, Pakistan.

" Some Observations on Parasites of Hilsa, " by Y.R. Tripathi, Barrackpore.

Hilsa is a species of considerable importance to India, Pakistan and Burma as well as in the river systems at the head of the Bay of Bengal. It is highly prized and the catch is great, though subject to fairly high fluctuations. In addition to the economic importance of the catch, there is renewed interest in the species arising out of the recent hypothesis that this fish plays a role in maintaining cholera endemicity in India. Under the auspices of the IPFC, assisted by FAO, a joint program of investigation, with emphasis on the racial aspects of the species, was recommended by the Sub-Committee.

## *General Fisheries Council for the Mediterranean*

The Executive Committee of the Council met in Paris, 1-3 September 1952. M. J. Girard, Secretary of the Council, attended on behalf of FAO. The Committee suggested that a general fisheries training

center and a training center in fish culture be held in the Mediterranean area. The next meeting of the Committee will be held in Split, Yugoslavia, in January 1953.

## Publications

The 1950/51 *Yearbook of Fisheries Statistics* will be available in January 1953. This Yearbook, in addition to bringing production and trade statistics on many countries up-to-date through 1951, contains much new information on the development of fishing fleets in most of the more important producing countries. Statistics are given on value, tonnage, horsepower and other features of fishing craft, wherever information has been available, for the years 1947-51 as compared with 1938.

The section on catch provides a breakdown of the world's total catch by species groups according to continents and the major channels in which the catch was used (i.e. fresh fish marketing, curing, canning, reduction to oil and meal, etc.). It also shows total quantities caught by country during the postwar years as compared with 1938 as well as a breakdown for important fish producing countries of the major species groups.

The section on utilization consists of two groups of tables. The first indicates channels of distribution — how the catches were used — in 1950/51. The second shows the weight of the end products for such commodities as frozen fish, salted cod, salted herring, canned products, fish meals and oils of the important fish processing countries.

The external trade section gives the major importing and exporting countries and the quantities entering into international trade during the years 1947-51 as compared with 1938. The country tables show quantities, values and destination of imports and exports.

To supplement the Yearbook, which is issued only biennially, more current fisheries statistics are now being published in every second issue of the *FAO Monthly Bulletin of Agricultural Economics and Statistics*. In addition, reprints of these statistics are inserted in the *FAO Fisheries Bulletin*. So far two reprints have been distributed.

## Fish Culture in the Caribbean Area

W. H. Schuster, Chief of the Inland Fisheries and Fish Culture Section, was in Haiti from 4 - 19 October, inspecting the FAO fish culture project there. Following discussions with government authorities and after visiting many places where fish farming operations were in execution or planned, he formulated proposals for continuing the project under FAO auspices in 1953. He later visited Cuba where he examined the possibilities of fish farming and advised the Ministry of Agriculture and the National Economics Board on measures for the improvement of production of inland waters. Schuster also

inspected several sugar plantations and advised the managers on converting swamplands into fish ponds and stocking lakes and rivers with fish. On his return trip to Headquarters he had discussions with the U.S. Fish and Wildlife Service in Washington on the recruitment of experts.

## Lectures

In September, Mogens Jul visited Vigo, Spain, and Lisbon, Portugal. He lectured on freshness testing of fisheries products in Vigo as part of the program of a summer course arranged by the University of Santiago. He also gave some lectures on fishing methods and on fish processing at meetings arranged by the Union of Fish Canners of Galicia. In connection with these lectures some films were shown illustrating FAO's activities in Latin America at the FAO Latin American Fisheries Training Center, Santiago, Chile.

## Personnel

H. Kristjonsson has transferred to the position of Fisheries Gear and Methods Technologist. His former position of Technical Assistance Officer for Fisheries Technology has been filled by D.D. Tapiador, of the Philippines. Mr. Tapiador, a graduate of the Polytechnic Institute of Manila, was formerly technologist at the Philippine Bureau of Fisheries.

Clyde Bender, statistical assistant in the Fisheries Division since 1948, recently resigned and has returned to the United States.

## Expanded Technical Assistance Program

The following progress has been made since the last Bulletin report (*see FAO Fisheries Bullettin*. Vol. 5, N°. 5, pp. 204-206). E. R. Kvaran of Iceland has accepted an assignment as Marine Engineer Superintendent for *Ceylon* and candidates have been nominated to the Government for the two posts for fish harbor development. Recruitment is still in progress for a marine biologist and a fisheries economist for Ceylon.

J. Fridthjof's assignment in *Chile* for increasing the consumption of hake will be completed in mid-December. The successor to Dr. E.M. Poulsen is likely to be appointed early in the new year to continue the biological project.

A draft agreement covering a commercial consultant and a fishery engineer for *Colombia* has been sent to the government for signature.

A draft agreement covering two biologists for *Costa Rica* is in preparation.

C. Gonzalez has completed his assignment to improve fish processing in *Ecuador* and has returned to his home in Argentina. Dr. E. Schweigger, who was conducting a fisheries biological survey in Ecuador, has also returned to his home in Peru.

A. C. Taft has completed his assignment in *Finland* and his report has been submitted to the government. Courses of study are being developed for the six fisheries fellowships for that country.

Shimon Tal, of Israel, has joined S.Y. Lin in *Haiti* on the fish culture project there, which is being extended for another year.

F. Botke continues his project of fresh water fisheries development in West Bengal, *India*. He has been joined by W.F.L. van der Heyden, of the Netherlands, who will concentrate on the development of fisheries in brackish waters.

M.O. Kristensen, of Norway, is on duty in Bombay as Commercial Fisheries Consultant.

A.E. Hofstede and G.S. Napier continue with their respective inland and marine fisheries projects in *Israel*. Mr. Hofstede is concentrating for the time being on the Sea of Galilee. Recruitment is in progress for a second biologist.

Mogens Jul, Chief of the FAO Fisheries Technology Branch, recently inspected the FAO fish processing and fisheries engineering projects in *Liberia*. An Accra canoe has been supplied for experimental use (*See Figure* 2).

L. Scattergood, of the United States, has taken up his assignment as shrimp biologist for *Panama*. Recruitment is still in progress for a biologist to study the tuna bait fisheries.

A draft agreement providing for one inland fisheries specialist is before the Government of *Paraguay* for signature.

H. Ogilvie and A. Frazer-Brunner went to *Aden* in early November to receive and outfit the fishery vessel *New Hope*, chartered in California, U.S.A. for exploratory fishing in *Italian Somaliland*. D. Byrd, of California, joined these officers in mid-November to assume duty as fisheries engineer.

# Notes on Films

SILDEFISKERI I NORDSØEN (Herring Fishing in the North Sea). Producer: Arvid Klemensen. Distributor: Statens Filmcentral, 1 Dahlerupsgade, Copenhagen V, Denmark. Technical data: 16 mm., color, silent, 335 feet (102 m.), 14 minutes running time, titles in Danish. Made in 1949 in consultation with the late Dr. Harald Blegvad.

One sees how a fishing boat is made ready for a trip to the herring fishing grounds near the coast of Scotland. A brief account is given of

the setting and hauling of a small herring trawl. Part of the catch is salted round aboard; part of it is iced in boxes in the holds. Additional ice is taken aboard from another boat at high sea.

M. J.

THE RIDDLE OF THE EEL (Aalens Livsmysterium). Producer: Fotorama A/S, Copenhagen, Denmark. Distributor: Statens Filmcentral, 1 Dahlerupsgade, Copenhagen V, Denmark. Technical data: 16 mm., black and white, silent, 836 feet (255 m.), 35 minutes running time, titles in Danish and English. Price: 16 mm. print with English titles, D. Kr. 300 (*Note*: As the original of the film was destroyed, prints may be of a somewhat inferior quality in certain places). Produced in 1938 in co-operation with Dr. Å. Vedel Tåning and Dr. Anton F. Bruun.

The film opens with examples of eel fishing in Denmark by hand-line, eel traps, and Danish seine of a special design. The eel is landed alive, size graded at grading tables, and stored in live tanks with running water.

The story of eels has long puzzled scientists. Tagging experiments showed that the fish go from the Baltic Sea to the Atlantic Ocean and do not return. On the other hand, small eels appear in the Baltic or in fresh water. There they develop into large fish. It is clear that they hatch in the ocean, but it took 20 years of scientific research to determine where. Various expeditions searched for eel larvae all over the Atlantic. Several shots show how water samples are taken by a research vessel and use of special net bags for the collection of eel larvae. Animated diagrams show the stations where larvae were found. Through such experiments it was finally possible to determine that eels hatch in the Sargasso Sea. Transformation of the larvae into small eels is also shown. Finally, one sees how small eels return to streams around the Baltic Sea.

Although a little out-of-date in technique, the film gives an interesting description of this special scientific work in fisheries biology.

M. J.

KUTTER H 71 (Cutter H 71). Producer: Ministeriernes Filmudvalg, Slotsholmsgade 10, Copenhagen K, Denmark. Distributor: Statens Filmcentral, Dahlerupsgade 1, Copenhagen V, Denmark. Technical data: 16 mm., black and white, sound, 918 feet (280 m.), 10 minutes running time, commentary and titles in Danish. Produced in 1943.

The film deals with the credit facilities which the Danish fisheries authorities offer to help fishermen obtain better boats. It shows how a young fisherman, who has fished on other boats for some time, obtains a loan which helps him to build his own boat. Inspectors ascertain that it is being built according to government specifications. In the meantime, the fisherman obtains his navigation certificate. The installation of the diesel engine with a variable pitch propeller is seen. Finally, the boat is launched, fitted out and taken to sea.

The film is useful to illustrate the Danish boat-building program. Most of the information given is contained in the commentary.

M. J.

OYSTER PRODUCTION AT CONWAY. Producer and distributor: Ministry of Agriculture and Fisheries, Fisheries Experiment Station, Castle Bank, Conway, England. Technical data: 16 mm. (reversal), black and white, silent, 700 feet, 30 minutes running time, titles in English, produced in 1949. By special arrangement with the distributor this film may be lent for copying in London. However, some alterations to the film will be made shortly.

The setting out of breeding oysters and the examination of breeding areas for spat formation are shown. The preparation of spat collectors in the form of round roof tiles and their distribution on the oyster beds follows. The collection in the second season shows the methods of obtaining the small oysters from the collectors and their distribution over the oyster beds. The fertilization of the beds with ground up limpets, etc., is also shown. Shots of the collection of the grown oysters in the third season, and their cleaning and sorting for marketing concludes the film.

E. H.

OYSTER CULTURE AND RESEARCH IN ESSEX. Producer and distributor: Ministry of Agriculture and Fisheries, Fisheries Experiment Station, Castle Bank, Conway, England. Technical data: 16 mm. (reversal), black and white, silent (for use with spoken commentary), 700 feet, 30 minutes running time, titles in English. Produced in 1951. By special arrangement with the distributor, the film may be lent for copying in London, but the titles are not yet complete.

A film similar to "Oyster Production at Conway" (*see above*) except that spat collectors in the form of cement-lined egg cartons are used instead of tiles.

E. H.

IMPERIALEN 00000. Producer: Ministry of Agriculture, Fisheries and Food, The Hague, Netherlands. Distributor: Ministry of Agriculture, Fisheries and Food Information Department. Technical data: 16 mm., black and white, sound, 720 meters, 60 minutes running time, commentary and titles in Dutch and French. Price: 220 guilders.

The film shows the various operations in cultivating oysters in the estuaries of the Schelde river near Yerseke in the southern part of the Netherlands. It illustrates the natural propagation of oysters, the settling of the larvae on artificial and natural collectors, the winning of oyster seed, and the efforts of the laboratory for oyster culture in Bergen op Zoom for bringing the industry to a higher level of efficiency. It shows how, in the second phase of the enterprise, the seed is planted on oysterbeds and the measures taken for the protection of the

crop, including re-collection of live oysters, and their storage in pits during the winter season. The film further illustrates the harvesting of the full-grown oysters, governmental control of the bacteriological purity of the product, the selection, handling and packing of oysters for distribution in the Netherlands and for export. A series of pictures the home life of the oyster farmers and their activities between the shows seasons.

The film is intended to inform the consumer of the enormous amount of effort required for the production of a first-class oyster, it stresses that it is reasonable to pay a high price for a product requiring five years of continual care before it can be sent to the market.

W. H. S.

# Notes on Publications

FWS 9.2 FISHERIES STATISTICS — ARGENTINA UDC 31 : 639.2 (82)

1951 Gonzalez, Carlos. Codificación de Estadísticas Pesqueras [Classification of Fisheries Statistics]. *Publicación Miscelanea* No. 346. Ministerio de Agricultura y Ganaderia, Buenos Aires, Argentina 21 pp. In Spanish.

Gives a brief account of purposes of analysis and subjects within the field of fisheries statistics with some emphasis on Argentine fisheries problems. Contains proposals for the establishment of a national system of fisheries statistics with a view to a more rational fish preservation policy.

FWS 9.11 OCEAN — U.S.A. UDC 551.46 (73)

1952 Riley, Gordon A. *et al.* Hydrographic and biological Studies of Block Island Sound. *Bulletin of the Bingham Oceanographic Collection* (Peabody Museum of Natural History, Yale University, New Haven, Connecticut, U.S.A.), Vol. 13, Article 3, July 1952. 237 pp. In English.

An extensive report of comprehensive investigations of Block Island Sound, adjacent to Long Island Sound on the east coast of the U.S.A. Presents in six papers data on hydrography collected during 9 cruises in 1946, on phytoplankton and pelagic fish eggs and larvae collected during 1949, on zooplankton collected during 1943-46 and 1949, and on herring (*Clupea harengus*).

FWS 9.11 OCEAN — BRAZIL UDC 551.46 (81)

Brazil, Instituto Paulista de Oceanografía. *Boletim* (Bulletin of the
1950 Paulista Institute of Oceanography], Vol. 1, No. 2. Departamento da Produção Animal, Secretaria da Agricultura, Governo do Estado de São Paulo, Brazil. 122 pp., illus. In Portuguese, with English summaries. Contains also one paper in English and another in French.

This issue of the series, started in 1950, contains 10 papers on oceanography, flora and fauna, plankton, taxonomy of fishes and crustaceans, and a section on Notes on Publications. The Institute is now part of the University of São Paulo, Brazil, and its name has been changed to Oceanographic Institute of the University of São Paulo (Instituto Oceanografico da Universidade de São Paulo).

FWS 9.1 MARINE BIOLOGY UDC 57

Blegvad H. (Ed.) *Annales biologiques* [Biological Annals] (Conseil per-
1951 manent international pour l'exploration de la mer, Charlottenlund Slot, Denmark), Vol. 7, December 1951. 158 pp., illus. In English. Price : D.Kr. 25.

This volume continues in the pattern established in previous issues : the summarized reporting of the essential biological features of fish stocks in various areas of interest to the Council. Notes are given on the environment and commercial fish stocks of seven areas ; special sections are devoted to herring and shellfish.

FWS 9.1 FISHERIES RESEARCH, BIOLOGICAL UDC 57 (262)
— FISH — HERRINGS, ETC.

Muzinic, Radosna. Tagging of Sardine (*Clupea Pilchardus* Walb . )in
1952 the Adriatic in 1950 and 1951. *Acta Adriatica* (Institute of Oceanography and Fisheries, Split, Yugoslavia), Vol. 4, No. 11. 19 pp., 4 fig. In English, with Yugoslav summary.

It contains the results of 38 tagging operations in which a total of 20,458 sardines were marked during the fishing seasons at the dark of the moon.

FWS 9.1 FRESH WATER BIOLOGY — SWEDEN UDC 57 (485)

Sweden, Institute of Fresh Water Research (Drottningholm). Annual
1951 Report for the Year 1950 and Short Papers. *Report No. 32* Fishery Board of Sweden. Carl Bloms Boktryckeri, Lund, Sweden. 152 pp., illus., tables, bibl. In English.

A detailed account of the activities of the staff of the Institute on the specification and control of fish populations, study of bottom and plankton fauna, fish populations in lakes and studies on fishing gear. Among the 11 papers published is an elaborate report on the successful transplantation of Coregonid whitefish into lakes resulting in a great increase in yield.

FWS 9.1 FRESH WATER BIOLOGY UDC 57 (71)

Smith, M.W. Limnology and Trout Angling in Charlotte County
1952 Lakes, New Brunswick. *Journal of the Fisheries Research Board of Canada* (Ottawa, Ontario, Canada), Vol. 8, No. 6, April 1952. 70 pp., tables, bibl. In English.

Report on the study to explore the limnological conditions and to assess the yields of speckled trout of 8 lakes in New Brunswick. Poor

mineralization and dystrophy conditioned a mediocre level of food production resulting in low yields of trout. The results of the investigation suggest that native trout is able to withstand adverse conditions better than introduced stock.

FWS 1.8 OYSTERS UDC 594

Knight-Jones, E.W. Reproduction of Oysters in the Rivers Crouch
1952 and Roach, Essex, during 1947, 1948 and 1949. *Fishery Investigations* (Ministry of Agriculture and Fisheries, London), Series II, Vol. 18, No. 2. 48 pp. In English. Price: 3s. 6d. net.

An account of investigations concerning the factors determining spatfall of oysters in the rivers Crouch and Roach on the east coast of England. The investigations included the study of hydrography and plankton, oyster spawning, larvae distribution and growth and the immediate circumstances of spatfall, including the presence of organisms competing with the oyster spat for space and the use of artificial collectors.

FWS 9.12 FISHES UDC 597.5

Bertelsen E. The Ceratioid Fishes, Ontogeny, Taxonomy, Distri-
1951 bution and Biology. *Dana-Report* No. 39. Andr. Fred. Høst & Son, Copenhagen, Denmark, Dec. 1951. 276 pp., 141 fig. 1 plate. In English. Price : £2. 10s. 0d. ; D.Kr. 50.

Reports exhaustively on the Ceratioid sub-order of the Lophiformes (*pediculati*) based on analysis of the Dana collection. Part I deals with the ontogeny and taxonomy of the group, giving notes on ontogeny and sexual dimophism, and a systematic revision of the sub-order with documentation of development and indentification of the males. Part II describes distribution, ecology and biology of the group.

FWS 1.6 FLATFISHES UDC 597.5

Ginsburg, Isaac. Flounders of the Genus Paralichthys and Related
1952 Genera in American Waters. *Fishery Bulletin* No. 71. United States Department of the Interior, Fish and Wildlife Service, Washington, D.C., U.S.A. 85 pp., illus. In English. Price : $0.60.

After a general discussion on structural differences which distinguish the species of these genera, and some account of such matters as color pattern, proportional measurements and change of form with size, the author gives a systematic account of 22 species in the genera *Hippoglossina*, *Pseudorhombus* and *Paralichthys*. The species information includes diagnosis, color, geographic distribution, size, distinctive characters and relationship, synonomy, economic importance and, in some cases present knowledge of the biology of this species.

FWS 1.2 HERRINGS, ETC. UDC 597.5

Richardson, I.D. Some Reactions of Pelagic Fish to Light as
1952 Recorded by Echo-sounding. *Fishery Investigations* (Ministry of Agriculture and Fisheries, London), Series II, Vol. 18, No. 1. 20 pp. In English. Price : 4s. 0d. net.

Report of a study of the reaction of fish shoals to daylight and electric light, observed by means of the echo-sounder. Reactions were taken of sprat, herring, pilchard and fish fry, and it is concluded that the diurnal vertical migration of sprat and herring is associated with light intensity, which is thought to be the operative cause.

FWS 1 COD, HAKE, ETC. — U.S.A. UDC 597.5 (73)

Schuck, Howard A. Studies of Georges Bank Haddock. Part I:
1951 Landings by Pounds, Numbers and Sizes of Fish. *Fishery Bulletin*, No. 66. United States Department of the Interior, Fish and Wildlife Service, Washington 25, D.C., U.S.A. 25 pp., 16 figs. In English.

The first of a series giving the results of a study being conducted to determine the causes of the decline of the most important fishery of New England, haddock, and to find ways of maintaining or increasing production together with predictions of future landings. It gives information on pounds, numbers, average weights and sizes of haddock landed from Georges Bank for the years 1931 to 1948. Information on trends and seasonal cycles in the landings is also given.

FWS 1 COD, HAKE, ETC. — U.S.A. UDC 597.5 (73)

Schuck, Howard A., and Arnold, Edgar L. Jr. Comparison of Haddock
1951 from Georges and Browns Banks. *Fishery Bulletin*, No. 67. United States Department of the Interior, Fish and Wildlife Service, Washington 25, D.C., U.S.A. 8 pp., 4 figs. In English.

Contains the data and results of the comparative study of the two banks which shows large differences on age compositions of the fish studied and very significant differences in the average size of the same ages of haddock from the two banks. This shows that there exists a significant difference in the rate of growth of this fish from the two areas and that they are two independent units strengthening the idea that they can be studied separately.

FWS 1.1 TUNAS, MACKERELS, ETC. — HAWAII UDC 597.5 (969)

Moore, Harvey L. Estimation of Age and Growth of Yellowfin
1951 Tuna (*Neothunnus macropterus*) in Hawaiian Waters by Size Frequencies. *Fishery Bulletin*, No. 65. United States Department of the Interior, Fish and Wildlife Service, Washington 25, D.C., U.S.A. 18 pp., 14 fig., appendix. In English.

An analysis of the growth rate of yellowfin tuna is presented and the estimates compared with other available data in the literature which shows that there is a fast growth of this tuna up to as much as 60 pounds a year.

FWS 9.12 FLATFISHES UDC 597.56

Orcutt, Harold G. The Life History of the Starry Flounder,
1950 *Platichthys stellatus* (Pallas). *Fish Bulletin* No. 78. Bureau of Marine Fisheries, Department of Fish and Game, Ferry Bldg., San Francisco, California, U.S.A. 64 pp., 52 fig. In English.

Covers distribution and habitat, commercial catch, feeding and food, rate of growth, larval development and other aspects of the life history of the starry flounder.

FWS 1.95 WHALES, DOLPHINS AND PORPOISES — JAPAN UDC 599.51 (52) 599.53 (52)

Miyazaki, Ichiro. Study on Maturity and Body Length of Whales
1952 Caught in the Waters Adjacent to Japan. Fisheries Agency of Japanese Government, issued from the Japan Whaling Association, Tokyo, Japan, May 1952. 27 pp., 29 fig. In English.

Contains a study of the time of maturity of the sei, fin and sperm whales caught in the waters adjacent to Japan during the years 1950

and 1951, based on the weight of ovary and testis, and number of *corpora lutea* in ovary by body length, and data on their size distribution. Reduced data on blue whales are also given. This study was done to review similar work by Omura (1950) who concluded that sei, fin and blue whales found in the waters adjacent to Japan become adult at a smaller size than the ones in the southern hemisphere, and that no local differences were found in sperm whales.

FWS 1.95 SEALS, SEA LIONS AND WALRUSES UDC 599.55 (71)
— CANADA

Fisher, H. D. The Status of the Harbour Seal in British Columbia
1952 With Particular Reference to the Skeena River. *Bulletin* No. 93. Fisheries Research Board of Canada, Ottawa, Canada. 58 pp., 17 fig. In English. Price : Can. $.0.50.

A study covering the distribution and habitat, movements, life history, parasites, diseases and food habits of the Pacific harbor seal, *Phoca vitulina richardii*, carried out with the view of ascertaining the amount of damage caused by them to the gill-net salmon fisheries and to recommend better ways for their control than those used at present.

FWS 0.8 WATER POLLUTION — U.S.A. UDC 628.3 (73)

United States Federal Security Agency. Ohio River Drainage Basin.
1951 *Public Health Service Publication* No. 136. Washington, D.C., U.S.A. xi + 128 pp., tables. In English.

Water use in the Ohio Basin includes industrial water supplies, navigation, power development, fish and wildlife propagation, and irrigation. Acid mine drainage is the greatest single pollution problem, but damages also result from bacterial vitiation, de-oxygenation, toxicity, chlorinity, and presence of color, odor or taste producing substances. Eight states joined in a compact for a co-operative approach to the pollution problem. The report reviews the activities of the water control agencies and present conclusions and recommendations for safeguarding the water resources.

FWS 2.115 NAVAL ARCHITECTURE UDC 629.12

Japan, Fisheries Agency. Technical Report of Fishing Boat, No. 2.
1951 Fishing Boat Laboratory, Fisheries Agency, 2-2 Kasumigaseki, Chiyoda-ku, Tokyo, Japan, March 1951. 112 pp., illus. In Japanese, with English summary.

Contains information on trials carried out with a torsion meter, insulation of fish holds, tank tests of fishing boat models, a new test boat to be built to carry out experiments on resistance and propulsion, and engine, compass and echo sounder research.

FWS 1 FISHERIES — DENMARK UDC 639.2 (489)

Lascaridi, K. and Kelaiditi, G. E alieutike oikonomia tes danias [Danish
1951 Fisheries Economy]. *Alieutikon deltion* No. 10. Hydrobiological Institute, Athens Academy, Athens, Greece, December 1951. 72 pp., illus. In Greek.

This report of a mission of the Greek Hydrobiological Institute to Denmark gives the physical features and organization of Danish fisheries, utilization of the catch, fishing methods, production, handling and processing, trade, social provisions and education of the fishermen, credit systems, fisheries research and inland fisheries.

FWS 1 FISHERIES — SPANISH MOROCCO UDC 639.2 (647)

Navarro, Francisco de P. and Lozano, Fernando. Carta de Pesca de la
1950 Costa del Sahara, desde el Cabo Juby al Cabo Barbas [Fishing Chart of the Coast of the Sahara from Cape Juby to Cape Barbas]. *Trabajos*, No. 21. Instituto Español de Oceanografía, Ministerio de Marina, Madrid, Spain. 24 pp., 3 charts. In Spanish.

A description of the five types of fisheries which take place on the coast of the Spanish Sahara illustrated by three fishing charts, along with a list of scientific and common names of the most important fishes found there.

FWS 1 FISHERIES — KENYA UDC 639.2 (676.2)

Copley, Hugh. Review of Kenya Fisheries, 1950. The Government
1951 Printer, Nairobi, Kenya. 52 pp., tables. In English. Price : 3s. 6d.

Surveys the work done by the fisheries officers in Kenya in 1950. Reference is made to the trout fisheries, stocking of rivers, operations by trout hatcheries, fisheries in the lakes, fish culture, research and investigation, and a report on the marine fisheries. The appendices provide detailed data on operations in fresh water fisheries, including stocking and trout hatcheries.

FWS 1 FISHERIES — BRAZIL UDC 639.2 (81)

Menezes, Rui Simões de. Contribuição ao Estudo da Piscicultura e Pesca
1951 Interior no Estado de Alagoas [Contribution to the Study of Fish Culture and Inland Fisheries in the State of Alagoas]. *Boletins* No. 1. Ministerio da Agricultura, Departamento Nacional da Produção Vegetal, Divisão de Fomento da Produção Vegetal, Secção de Fomento Agricola no Estado de Alagoas, Maceió, Alagoas, Brazil. 49 pp., 6 figs. In Portuguese.

Describes the fisheries in the coastal lakes and San Francisco River in the State of Alagoas, and makes observations on the fish culture work to be developed there.

FWS 9.1 FISHERIES RESEARCH, BIOLOGICAL UDC 639.2.001.5

International Council for the Exploration of the Sea. Contributions
1951 to Special Scientific Meetings, 1949. *Rapports et procès-verbaux des réunions*, Vol. 128. Andr. Fred. Høst & Fils, Copenhagen, Denmark. Part I. 74 pp., illus. ; Part II. 96 pp., illus. In English and French. Price: Part 1, D.Kr. 12 ; Part II, D.Kr. 15.

The first part, "Herring Investigations," encompasses 11 technical reports ; the second, "Shellfish Investigations," contains 20 papers on mollusks and crustacea.

FWS 2.117 FISHERIES RESEARCH VESSELS UDC 639.2.001.5

Marchand, J.M. ; Shannon, R.L.V. ; Clark, A. The Fisheries Research
1951 Ship *Africana II*. *Fisheries Bulletin* No. 3. Supplement to "Commerce & Industry," Fisheries and Marine Biological Survey Division, Department of Commerce and Industry, Cape Town, South Africa, December 1951. 47 pp., illus. In English.

Description of the new fisheries research vessel *Africana II*, including notes on construction and design, descriptions of deck arrangements and

living quarters, engine arrangements, laboratories and scientific equipment. Illustrated with photographs and general arrangement drawings.

FWS 9.1 FISHERIES RESEARCH, BIOLOGICAL — DENMARK UDC 639.2.001.5 (489)

Blegvad, H. Report of the Danish Biological Station to the
1951 Ministry of Fisheries, No. 53. C.A. Reitzel, Copenhagen, Denmark. 39 pp., illus. In English, with Danish summaries.

Contains the following three studies: "Fluctuations in the Amounts of Food Animals of the Bottom of the Limfjord in 1928-1950," by H. Blegvad; "Changes in the Frequency of Larger Bottom Invertebrates in the Limfjord in 1927-1950," by E.M. Poulsen; and "Two Danish Finds of Female Eel (*Anguilla anguilla*) in Spawning or Partial Spawning Dress," by C.J. Rasmussen.

FWS 9.16 FISHERIES MANAGEMENT — NORTH ATLANTIC OCEAN UDC 639.2.058 (261)

International Commission for the Northwest Atlantic Fisheries. Report
1951 of the First Annual Meeting, 2-10 April 1951. *Department of State Publication* 4244. United States Department of State, Washington, D.C., U.S.A. 52 pp., 1 chart.

This, the first report of the recently established Commission, is the definitive document for those interested in the development of the Commission's work. Includes the report of the first meeting, and appendices with the International Convention by which the Commission was established, the Rules of Procedure and other documentation relating to the establishment of the Commission and the conduct of its work.

FWS 9.16 FISHERIES MANAGEMENT — EASTERN PACIFIC OCEAN UDC 639.2.058 (266)

International Fisheries Commission (Halibut). Regulation and Inves-
1951 tigation of the Pacific Halibut Fishery in 1950. *Report* No. 16. Seattle, Washington, U.S.A. 16 pp., charts. In English.

Following the pattern of the previous three annual reports of the Commission, this document describes the activities of the Commission during 1950 in connection with the regulation of the halibut fishery of the north-eastern Pacific by Canada and the United States and with statistical and biological observations. 1950 regulations are reported. Statistics of landings and notes on the abundance of halibut in Area 2, between Willapa Bay and Cape Spencer, Alaska, and Area 3, between Cape Spencer and a line running due west from Cape Sarichef on Unimak Island, and of changes in composition of stocks, are given.

FWS 2.116 DETECTION OF FISH — ECHO SOUNDING UDC 639.2.081.72

Japan, Fisheries Agency. Study on the Ultrasonic Echo-sounder
1951 Fish-finder and its Applications. *Fishing Boat Series II.* Tokyo, Japan, December 1951. 150 pp., illus. In Japanese, with English summary.

A detailed report on the work of Mr. Tomiju Hashimoto and other staff members of the Japanese Fishing Boat Laboratory on the application of echo sounders for the detection of fish. Analysis is made of some of the characteristics of the three general types of echo sounders currently used in Japan, i.e., the 14.5 kc English, 50 kc American and cathode-ray oscillograph German type. Among the subjects covered are

ultrasonic reflection of fish bodies, fishing nets and sea bottom ; identification of fish traces ; propagation of ultrasonic sound waves, both in vertical and horizontal direction (by mounting the transducer on the side of the vessel) ; transducers and their installation ; effect of anticorrosive paint, etc. ; dry and wet recording paper and, finally, some remarks on deep sea echo sounding (down to 10,000 meters, 5,500 fathoms), sounding in rivers and shallow waters and sounding upwards from the bottom.

FWS 2.112 FISHING METHODS AND GEAR — TRAPS UDC 639.2.081.111

Miyamoto, H. Study on the Set-net. *Bulletin of Tokai Regional*
1951 *Fisheries Research Laboratory* (Tsukishima, Tokyo, Japan), No. 2 (Contribution A. No. 2), January 1951. 122 pp. In Japanese, with English summary.

Gives the classification and essential details of set nets by which nearly one-fourth of the marine catch of Japan is obtained. Description of model tests to study the effect of tidal currents on them and evaluation of the results obtained are also given.

FWS 2.112 FISHING METHODS AND GEAR — SEINES UDC 639.2.081.117

Scofield, W.L. Purse Seines and Other Roundhaul Nets in Cali-
1951 fornia. *Fish Bulletin* No. 81. Bureau of Marine Fisheries, Department of Fish and Game, Ferry Building, San Francisco, California, U.S.A. 83 pp., 37 fig., bibl. In English.

Describes the construction and operation of roundhaul nets such as purse seines, lamparas, ring nets and bait nets, in the State of California as observed by various staff members of the Bureau of Marine Fisheries during the last 30 years. The history and developments are summarized and numerous improvements are described.

FWS 9.15 FISH PESTS — CONTROL UDC 639.2.09

Applegate, Vernon C. ; Smith, Bernard R. ; McLain, Alberton L. ; and
1952 Patterson, Matt. Sea Lamprey Spawning Runs in the Great Lakes, 1951. *Special Scientific Report : Fisheries*, No. 68 United States Department of the Interior, Fish and Wildlife Service, Washington 25, D.C., U.S.A., March 1952. 37 pp illus. In English.

A progress report on the long-term project for the development of methods of suppressing or controlling the parasitic sea lamprey. Contains summaries of data concerning experimental operations and reports on development of mechanical control devices. Gives a comparison of the biological characteristics of the spawning runs of 1951 with those of previous years.

FWS 1.2 FISHERIES INDUSTRIES — HERRINGS, ETC. — UNITED KINGDOM UDC 639.222 (410)

Herring Industry Acts 1935 to 1948. H.M. Stationery Office, London.
1951 17 pp. In English. Price : 9d.

Gives the draft scheme intended to replace the Herring Industry Scheme 1935 as amended by the Herring Industry (Amending) Scheme

1946. This draft Herring Industry Scheme 1951 defines the terms used, reorganization and development of purchase schemes, regulations applying to licences, rules, directions, controls and prohibitions, and offences. The latter part refers to financial provisions and general administration.

FWS 1.2 FISHERIES INDUSTRIES — HERRINGS, ETC. — U.S.A. UDC 639.222 (73)

Schaefer, Milner B. ; Sette, Oscar E. ; and Marr, John C. Growth of Pacific Coast Pilchard Fishery to 1942. *Research Report* No. 29. United States Department of the Interior, Fish and Wildlife Service, Washington 25, D.C., U.S.A. ii + 31 pp., tables, graphs. In English. Price : U.S. $ 0.20.
1951

Discusses historically and statistically the early Pacific Coast pilchard fishery and its growth until 1942; the growth curve and fluctuations in relation to the economic trends are surveyed. The last part discusses the regulations enforced on the industry from 1917 to 1942 in British Colombia, Oregon, Washington and California. A bibliography is appended.

FWS 2.14 WHALING — JAPAN UDC 639.245.1 (52)

Japan, Fisheries Agency. Report on Whale Marking in Japan, Nos. 1-3. Published by the Committee for the Improvement of Equipment of Whaling Vessels, Tokyo, Japan. No. 1, 18 pp.; No. 2, 45 pp., 9 charts ; No. 3, 13 pp., 17 fig. In English.
1951

No. 1 reports on 1950 marking experiments in the Bonin Islands area. It gives data on the type of boat, marking darts used, results of test-shooting, and recovery of marked whales. Report No. 2 contains the results of the whale marking and a hydrographical survey of the whaling grounds made simultaneously in the North Pacific area in 1950. Report No. 3 contains the results of the work carried on in 1951 in the areas of the Bonin Islands and Sanriku-Hokkaido ; it covers information on the improvement of marking darts, study of the swimming direction of the whales, capture of marked whales and oceanographic observations made in the area of work.

FWS 9.12 FISHERIES MANAGEMENT — FISHWAYS — FISH LADDERS UDC 639.313

Furuskog, Valter. Vattenkraften och Fisket [Water Power and the Fisheries]. *Publikation* 420 (1951 : 3). Svenska Vattenkraftföreningen, Norrlandsgatan 16, Stockholm, Sweden. 20 pp charts. In Swedish. Price : S.Kr. 2.
1951

Describes the accelerated development of Sweden's hydro-electric plants which have a severe effect on the fisheries. The consumption of electric energy increases by 7% per annum, which means a doubling of the capacity in 10 years. Describes new fish ladder constructions in Swedish rivers and gives a number of profile drawings of Swedish rivers.

FWS 9.16 SHELLFISH PESTS — MOLLUSKS UDC 639.4.09

Cole, H.A. The American Slipper Limpet (*Crepidula Fornicata L.*) on Cornish Oyster Beds. *Fishery Investigations* (Ministry of Agriculture and Fisheries, London), Series 2, Vol. 17, No. 7. H.M. Stationery Office, London. 13 pp., 2 fig. Price: 2s. Od. net,
1952

Describes colonies of American slipper limpet found in oyster beds, discusses the possible means by which this pest was spread since its introduction from North America together with the American Atlantic oyster (*Gryphaea virginica*), and suggests measures to combat its growth on the Cornish oyster beds.

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